

Ensemble of sea ice initial conditions for interannual Ec-Earth climate predictions: Improved forecast quality over the Arctic

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Sea ice predictability



- **Sea ice area persistence 2-5 months**
- **Re-emergence up the 15 months (Blanchard-Wrigglesworth et al, 2011) : summer-to-summer (memory in the thickness), winter-to-spring (memory in the SST)**
- **Summer Arctic sea ice thickness precursor of winter sea ice extent (Chevallier and Salas-Melia, 2012)**

Issue for initialization : sparse observational coverage



➤ **Before 1973 :**

Arctic : monthly sea ice extent estimates

Antarctic : climatologies 1929-1937 & 1947-1962

➤ **From 1973 : quasi weekly estimates of sea ice concentration, US Navy, Canadian, Danish aerial reconnaissance**

➤ **From 1978 : 2-day frequency later daily, gridded, 1°, satellite microwave imagery**

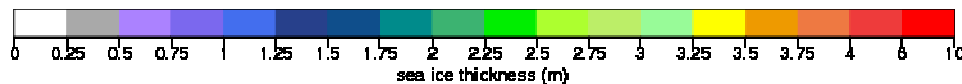
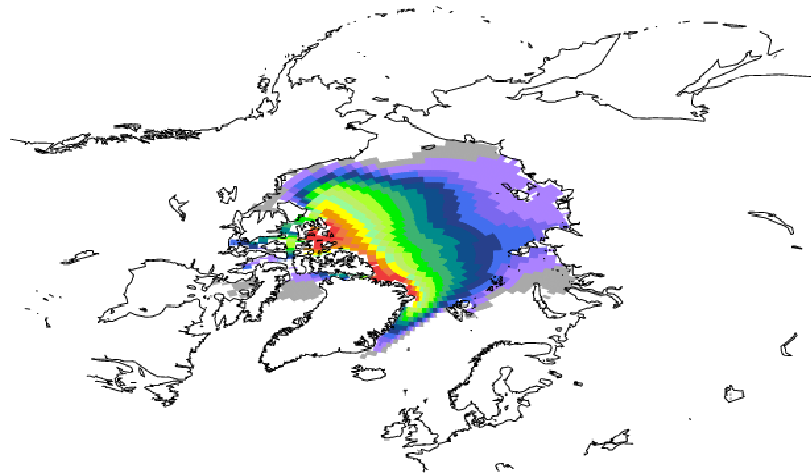
➤ **First sea ice thickness dataset in 2010 : submarine, ULS**

Sea ice simulations constrained by ocean and atmosphere observations

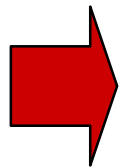
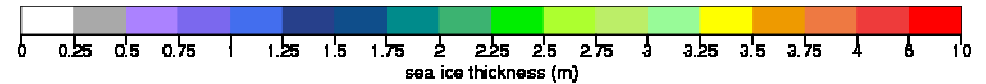
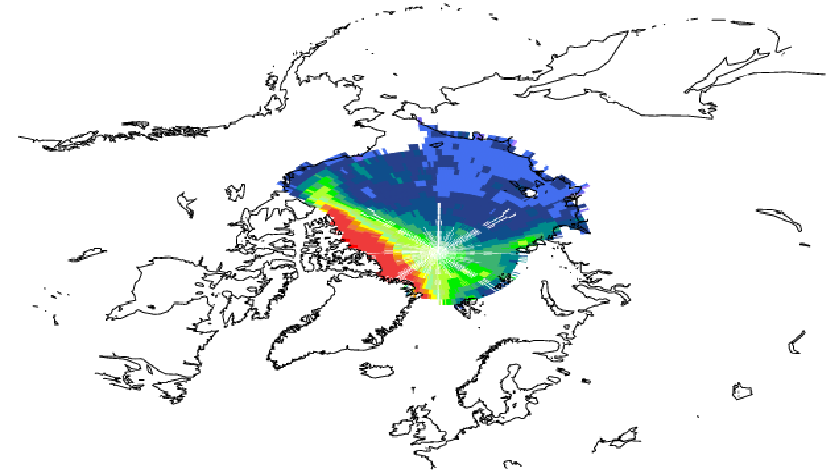
- NEMO3.2 ocean model + LIM2 sea ice model
- Forcings : 1958-2006 DFS4.3 or 1979-2010 ERA-interim
- Nudging : T and S toward ORAS4, timescales = 360 days below 800m, and 10 days above except in the mixed layer, except at the equator (1°S-1°N), SST & SSS restoring (-40W/m², -150 mm/day/psu)
- Wind perturbations + 5-member ORAS4 - - - > 5 members for sea ice reconstruction

October-November Arctic sea thickness

Reconstruction



IceSat



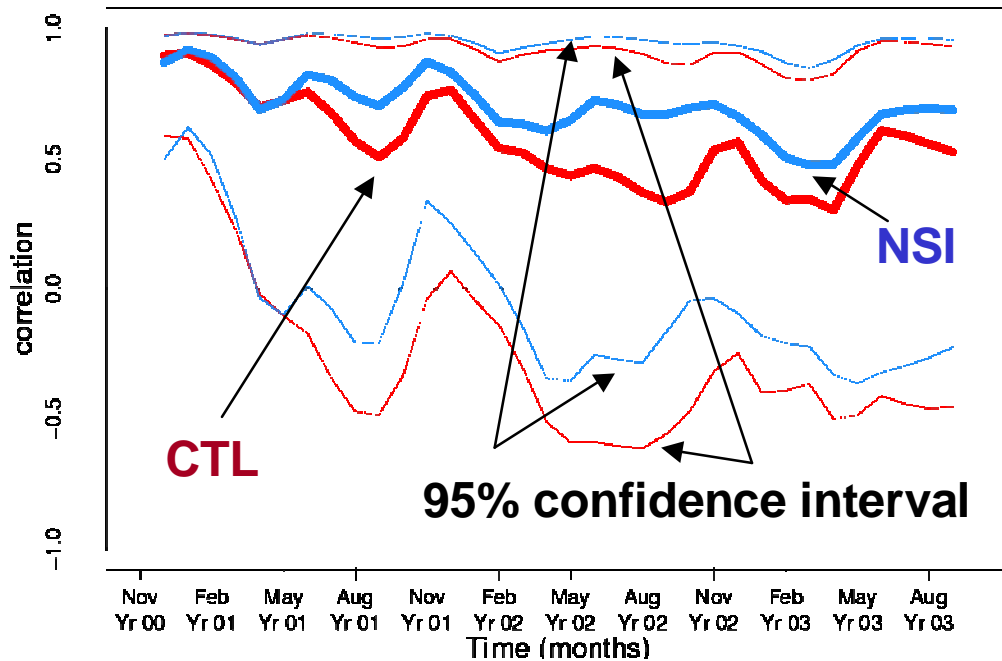
Too much ice in central Arctic, too few Chucki/East Sib Seas

Climate predictions initialized from those sea ice conditions

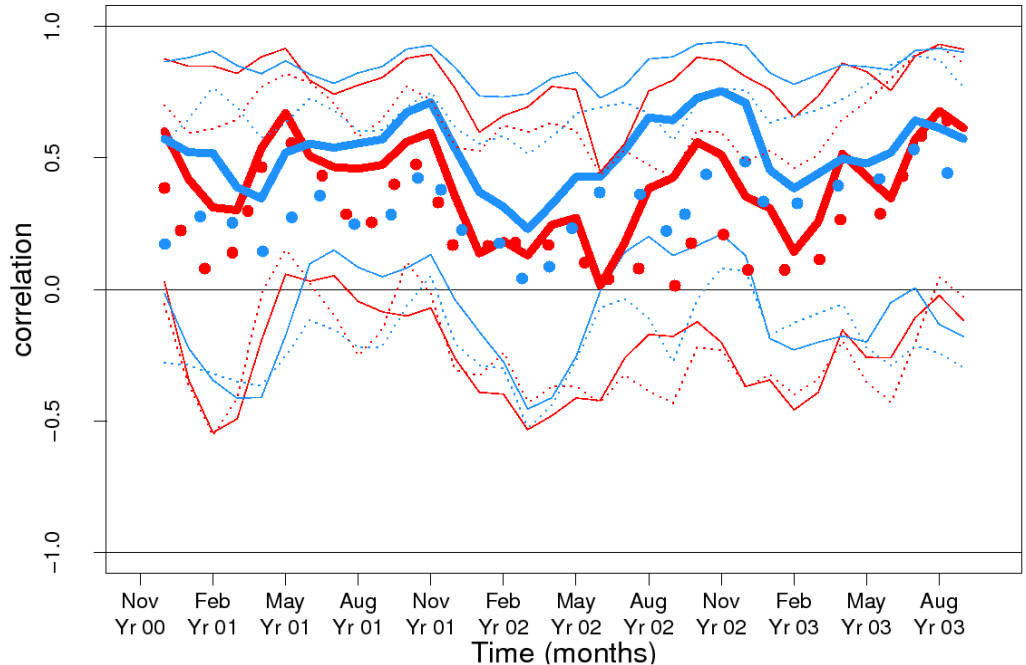
- Initialization every 2 years from 1960 to 2004 + 1965 + 1975 + 1985 + 1995 + 2005 on 1 November = 28 forecasts
- Ocean from ORAS4, Atmosphere from ERA40/ERAInt
- With Ec-Earth 2.3
- Sensitivity experiment with New Sea Ice initial conditions = NSI is compared to the CMIP5 contribution = CTL

Improved forecast skill in the Arctic

ACC Arctic sea ice area



ACC Arctic 2m temperature

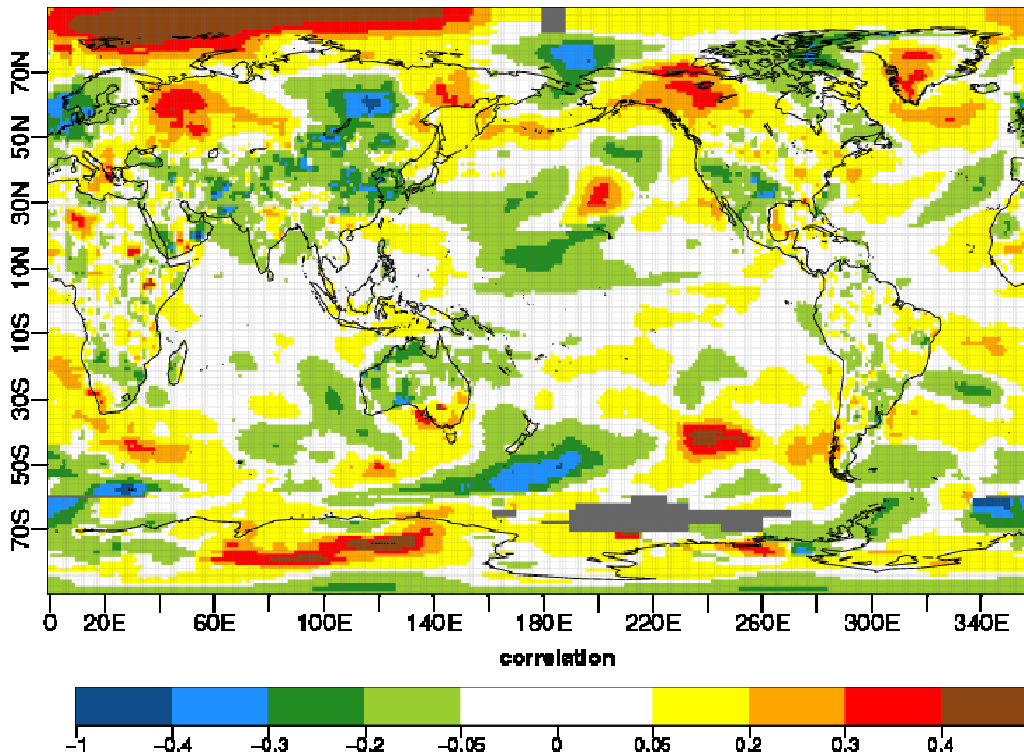


Although not significant, larger ACC in the Arctic region

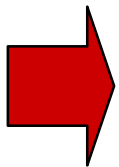
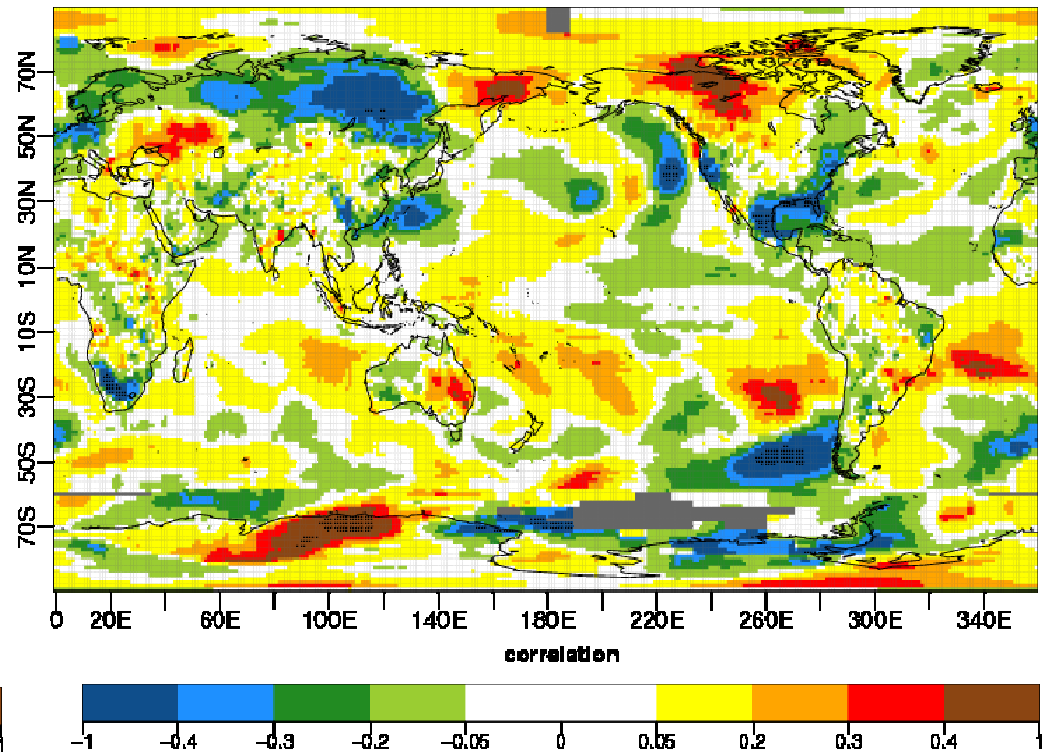
Improvement confined to the Arctic

2m temperature

ACC NSI – ACC CTL Year 1



ACC NSI – ACC CTL Year 2

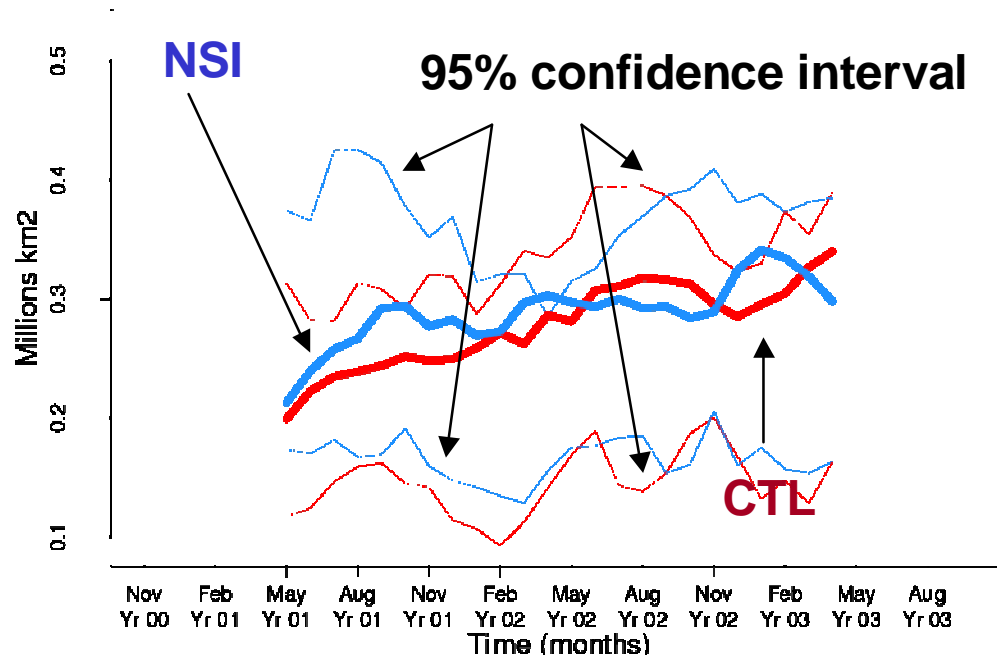


Nothing significant but improvement all over the Arctic

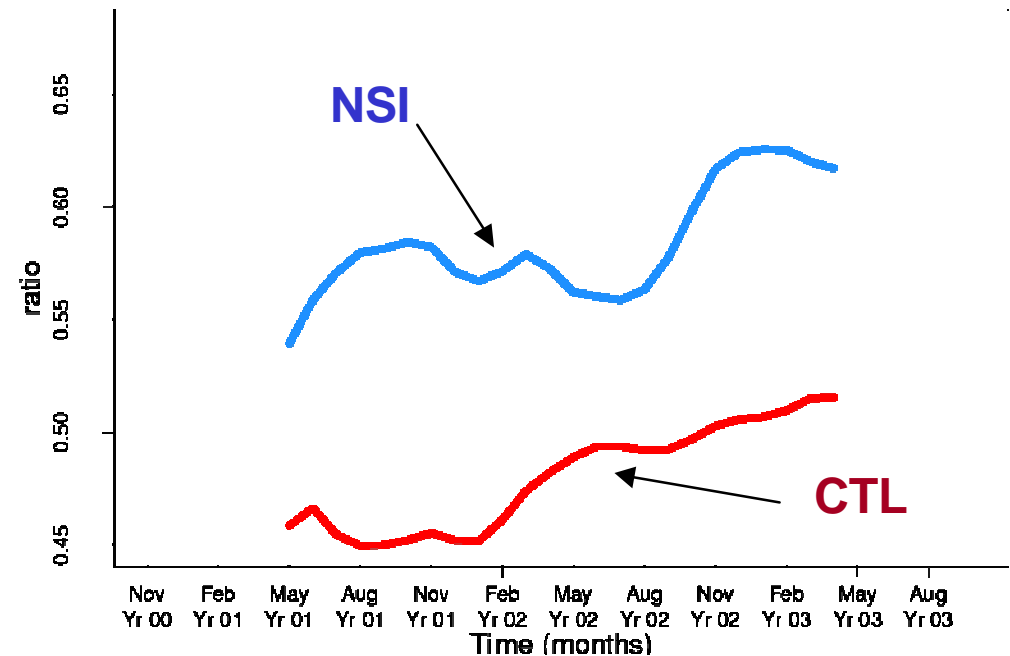
Larger spread between the members

Arctic Sea Ice Area

IQR (members)



SD (members) / RMSE



Larger spread between members for sea ice variables

Conclusions

5-member Sea Ice Reconstruction:

- Too much sea ice in the central Arctic, too few in the Chucki and East Siberian Seas
- Reasonable agreement of the Arctic sea ice interannual variability with NSIDC and HadISST

Climate predictions initialized from this 5-member reconstruction:

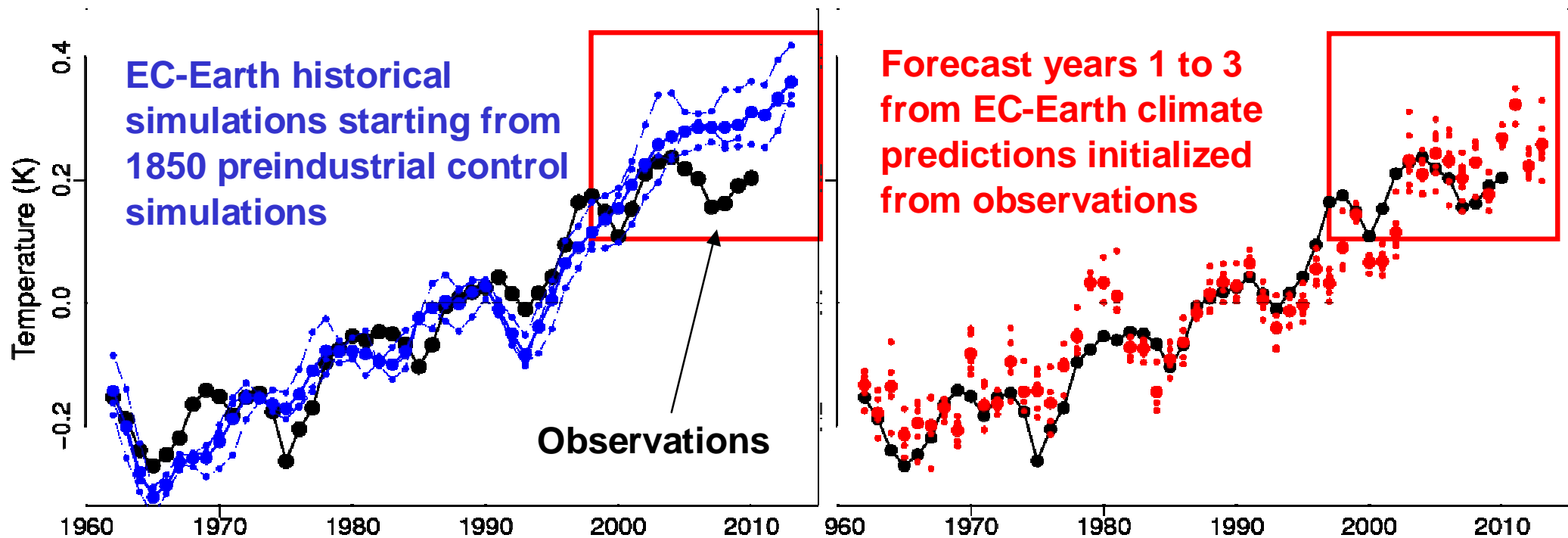
- Although the differences are not significant, the ACC is increased for Arctic sea ice area and 2m temperature
- The increase in ACC for 2m temperature is confined to the Arctic
- The spread between members is larger for sea ice variables, thus more representative of the forecast error

A quick overview of :

Guemas V., Doblas-Reyes F., Andreu-Burillo I., Asif M., **Retrospective prediction of the global warming slowdown in the past decade, *Nature Climate Change*, doi:10.1038/nclimate1863.**

Successful climate prediction of the 2000-2010 global temperature plateau

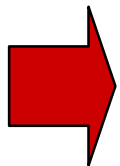
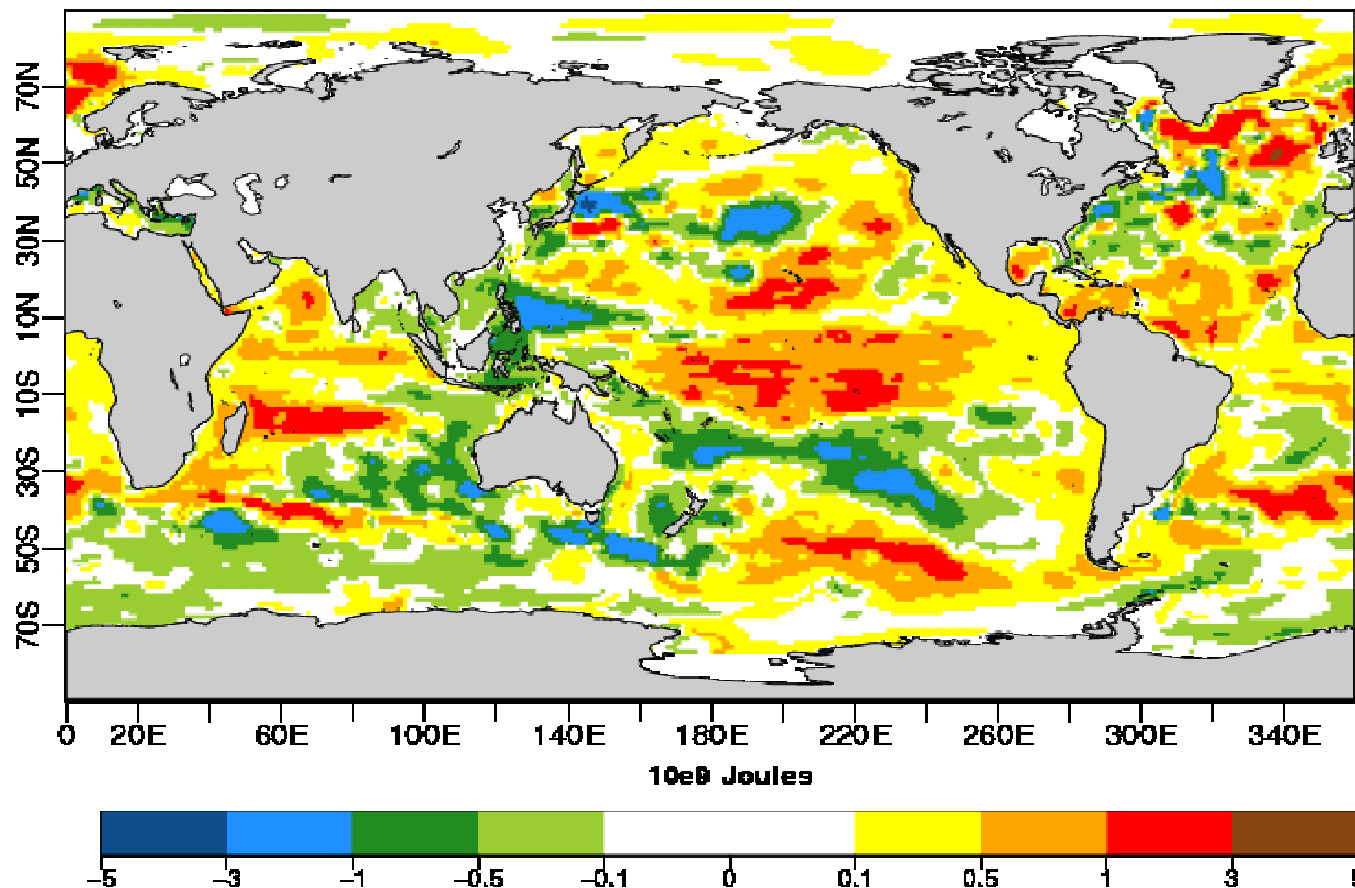
Global mean Sea Surface Temperature



➔ **Initializing from observations is crucial to capture the plateau**

Analysis of these predictions to attribute the 2000-2010 global temperature plateau

Ocean heat uptake (0-800m excluding the mixed layer) at the onset of the plateau



The plateau seems due to increased ocean heat absorption



Climate Forecasting Unit



**Thank you very much for
your attention**

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